



## INVOLUTE D.R.I. TUNNEL FURNACE

A tunnel furnace has been uniquely designed, developed, and successfully demonstrated for the production of Direct Reduced Iron (D.R.I), also known as sponge iron. This furnace enables the manufacturing of steel ingots by melting sponge iron and also the production of iron powders suitable for sintered components via Powder Metallurgy techniques.

These sponge irons, of much superior quality, have been produced using various iron oxides such as:

- Haematite
- Magnetite
- Combined forms of the above
- Iron ores in the form of pebbles, fines, or dusts
- Iron mill scales in powder form

Additionally, successful trials have been carried out for:

- Direct reduction of cobalt oxides and manganese oxides
- Decarburisation of cast iron to produce sponge iron using mill scales

This makes the furnace a **multi-purpose, uniquely designed system** for any reducible oxide through solid-state reduction.

### Applications demonstrated include:

- D.R.I. from magnetite, haematite, and mill scales
- D.R.I. via decarburisation of cast iron turnings with mill scales
- MnO<sub>2</sub> decomposition and reduction
- Carbon reduction of cobalt oxides

### Innovative Furnace Design

This furnace uses **specialty formulated ceramic saggars**, unlike conventional silicon carbide (SiC) saggars. Raw materials are charged into these saggars for heat treatment. The saggars are stacked on trolleys that continuously pass through various temperature zones in the furnace.

Unlike traditional rotary kilns for DRI—which emit large volumes of black smoke—this tunnel furnace design is **entirely smokeless**, providing a clean and eco-friendly alternative.

### Fuel and Energy Efficiency

This system supports a variety of fuels, either independently or in combination:

- Natural Gas

- Petroleum Gas
- Raw Petroleum Coke
- Furnace Oil

Fuel sources can be switched even during midstream operations. Notably:

- Coal or carbonaceous reductant usage is **reduced to less than half** compared to traditional methods
- Electrical power load is **approximately 25%** of that required by conventional rotary kilns

#### **Summary of Benefits**

- **Cost-effective** operations
- **Higher-quality** product output
- **Lower capital investment**
- **Eco-friendly**, smokeless process
- **Fuel flexibility** and **energy efficiency**

This innovation stands as a **unique and environmentally sustainable tunnel furnace system**, promising a transformative shift in sponge iron production.